

FORM PTO-1000 (REV. 11-96)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEYS DOCKET NUMBER 4231/PCT
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371			U.S. APPLICATION NO. (if known) 09/914932 (not known to be assigned)
INTERNATIONAL APPLICATION NO. PCT/EP00/01770	INTERNATIONAL FILING DATE 01. March 2000 (01.03.00)	PRIORITY DATE CLAIMED 04. March 1999 (04.03.99)	
TITLE OF INVENTION METHOD FOR PRODUCING CIRCUIT ARRANGEMENTS			
APPLICANT(S) FOR DO/EO/US Helmut HEINZ; Bernhard SCHUCH			
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information			
<p>1. <input checked="" type="checkbox"/> This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371</p> <p>2. <input type="checkbox"/> This is a <b>SECOND</b> or <b>SUBSEQUENT</b> submission of items concerning a filing under 35 U.S.C. 371</p> <p>3. <input checked="" type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1)</p> <p>4. <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date</p> <p>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2))</p> <p>a. <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau).</p> <p>b. <input checked="" type="checkbox"/> has been transmitted by the International Bureau.</p> <p>c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US).</p> <p>6. <input checked="" type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)), with Translator's Declaration.</p> <p>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))</p> <p>a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau)</p> <p>b. <input checked="" type="checkbox"/> have been transmitted by the International Bureau.</p> <p>c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired</p> <p>d. <input type="checkbox"/> have not been made and will not be made.</p> <p>8. <input checked="" type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)), with Trans. Declaration.</p> <p>9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)), (UNEXECUTED) for information only.</p> <p>10. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</p>			
Items 11. to 16. below concern document(s) or information included:			
<p>11. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98, Form PTO-1449, 1 reference, copy of Int. Search Report, copy of German Office Action.</p> <p>12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included</p> <p>13. <input checked="" type="checkbox"/> A <b>FIRST</b> preliminary amendment.</p> <p><input checked="" type="checkbox"/> A <b>SECOND</b> or <b>SUBSEQUENT</b> preliminary amendment.</p> <p>14. <input type="checkbox"/> A substitute specification.</p> <p>15. <input type="checkbox"/> A change of power of attorney and/or address letter.</p> <p>16. <input checked="" type="checkbox"/> Other items or information:</p> <p>a. a return receipt postcard;</p> <p>b. 2 Figs. on 1 sheet of formal drawings;</p> <p>c. Form PTO-2038 (\$860.00 to cover the filing fee)</p>			
NOTE: The priority of German Patent Application 199 09 505.1, filed in the Federal Republic of Germany on March 4, 1999 is claimed under 35 USC §119.			
USPS EXPRESS MAIL EL 897 676 535 US SEPTEMBER 04 2001			

U.S. APPLICATION NO. (if known) 37 CFR 1.53 (Not known to be assigned) 09/914932		INTERNATIONAL APPLICATION NO. PCT/EP00/01770		ATTORNEY'S DOCKET NUMBER 4231/PCT	
17. <input checked="" type="checkbox"/> The following fees are submitted: <b>BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5)):</b> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO ..... <del>\$978.00</del> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO ..... <del>\$860.00</del> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO ..... <del>\$760.00</del> International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) ..... <del>\$670.00</del> International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) ..... <del>\$978.00</del> <b>ENTER APPROPRIATE BASIC FEE AMOUNT =</b>				<b>CALCULATIONS</b> PTO USE ONLY \$ 860.00	
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$ 0	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	5 - 20 =	0	X \$18.00	\$ 0	
Independent claims	1 - 3 =	0	X \$78.00	\$ 0	
MULTIPLE DEPENDENT CLAIM(S) (if applicable) (See Pre-Amendments) + \$260.00				\$ 0	
<b>TOTAL OF ABOVE CALCULATIONS =</b>				\$ 860.00	
Reduction of 1/2 for filing by small entity, if applicable. A Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28).				\$ 0	
<b>SUBTOTAL =</b>				\$ 860.00	
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				\$ 0	
<b>TOTAL NATIONAL FEE =</b>				\$ 860.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property				\$ 0	
<b>TOTAL FEES ENCLOSED =</b>				\$ 0	
				Amount to be:	\$
				refunded	\$
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- a. ☒ Form PTO-2038 (Credit Card Payment Form)  
 A check in the amount of \$860.00 to cover the above fees is enclosed.
- b. ☐ Please charge my Deposit Account No. \_\_\_\_\_ in the amount of \$\_\_\_\_\_ to cover the above fees.  
 A duplicate copy of this sheet is enclosed.
- c. ☒ The Commissioner is hereby authorized to charge any deficiency in or additional fees which may be required, or credit any  
 overpayment to Deposit Account No. 50-0507. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO

CUSTOMER NO.: 021553

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W. G. Fasse

NAME

21187

REGISTRATION NUMBER

09/914932

Rec'd PCT/PTO 04 SEP 2001

DOCKET NO.: 4231/PCT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN THE MATTER OF THE **NEW PCT NATIONAL PHASE PATENT APPLICATION**

OF: Helmut HEINZ et al.

USSN: TO BE ASSIGNED

FILED: September 4, 2001

FOR: Method for Producing Circuit Arrangements

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EL 897 676 535 US

SEPTEMBER 04 2001

INTERNATIONAL SERIAL NO.: PCT/EP00/01770

INTERNATIONAL FILING DATE: 01. MARCH 2000 (01.03.00)

COMMISSIONER FOR PATENTS

BOX PCT

WASHINGTON, D. C. 20231

September 4, 2001

FIRST PRELIMINARY AMENDMENT TO MINIMIZE THE FILING FEE

Dear Sir:

In order to minimize the filing fee, please amend the above identified patent application as follows before calculating the filing fee.

Referring to the Literal Translation of International Application  
PCT/EP00/01770

In the Claims:

Please cancel claims **2 to 6**.

Claim **1** is maintained for calculating the filing fee.

REMARKS:

After calculating the filing fee, please further enter the accompanying Second Preliminary Amendment which adds new claims **7 to 11** for examination.

Respectfully submitted,

Helmut HEINZ et al.

Applicant

By

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WGF:ar/4231/PCT  
Encls.: postcard

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DOCKET NO.: 4231/PCT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
IN THE MATTER OF THE **NEW PCT NATIONAL PHASE PATENT APPLICATION**  
OF: Helmut HEINZ et al.

USSN: TO BE ASSIGNED

FILED: September 4, 2001

FOR: Method for Producing Circuit Arrangements

INTERNATIONAL SERIAL NO.: PCT/EP00/01770  
INTERNATIONAL FILING DATE: 01. MARCH 2000 (01.03.00)

COMMISSIONER FOR PATENTS  
BOX PCT  
WASHINGTON, D. C. 20231

September 4, 2001

SECOND PRELIMINARY AMENDMENT

Dear Sir:

After calculating the filing fee, but before the first examination, please amend the above identified application as follows.

Referring to the Literal Translation of International Application  
PCT/EP00/01770

In the Claims:

Please cancel claim **1** and enter new claims 7 to 11 as follows.  
Claims **2 to 6** have been cancelled by the First Preliminary Amendment to Minimize the Filing Fee.

Please enter new claims **7 to 11** for examination.

- 1     **7.**     (new) Method for producing of circuit arrangements, the
- 2             components of which are attached to the top surface (12) of
- 3             a carrier body (5) having thermal lead-through contacts
- 4             (7), wherein, prior to the soldering operation, the thermal
- 5             lead-through contacts (7) are closed from the underside

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6 (13) of the carrier body (5) with screen printing material  
7 (8) by a screen printing process, and wherein a first  
8 metallizing layer (6) forming the base metallization, is  
9 applied on the carrier body (5) and in the thermal lead-  
10 through contacts (7), characterized in that a highly  
11 viscous screen printing material (8) is printed on the  
12 metallizing layer (6) forming the base metallization, that,  
13 following the curing of the screen printing material (8),  
14 remainders of the screen printing material (8) protruding  
15 from the underside of the carrier body (5) are removed by  
16 at least one mechanical cleaning process and/or by a  
17 chemical cleaning process, and that, following said at  
18 least one cleaning process, at least one further  
19 metallizing layer (17) forming the finished metallization  
20 is applied onto the metallizing layer (6) forming the base  
21 metallization.

1 8. (new) The method of claim 1, characterized in that  
2 mechanical brush grinding is used as said mechanical  
3 cleaning operation.

1 9. (new) The method of claim 1, characterized in that  
2 following the application of the metallization layer (17)  
3 forming the final metallization, the components of the  
4 circuit arrangement are attached to the top surface (12) of  
5 the carrier body (5) by a reflow soldering process.

1 10. (new) The method of claim 1, characterized in that a  
2 thermally conducting, electrically insulating film (9) is  
3 applied to the underside (13) of the carrier body (5).

1 11. (new) Method of claim 1, characterized in that said  
2 thermally conducting, electrically insulating film (9) is  
3 connected to a cooling body (10).

REMARKS:

- 1), Examination of the present U. S. National Phase Application is to proceed on the basis of claims 7 to 11. Claims 7 to 11 are directly based on the PCT International Application claims 1 to 5, incorporating the amendments under PCT Article 19, as literally translated into English, except for omitting multiple dependencies.
- 2) Favorable consideration and allowance of claims 7 to 11 are respectfully requested

Respectfully submitted,

Helmut HEINZ et al.  
Applicant

WGF:ar/4231/PCT  
Encls.: postcard

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106201-2647650

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LITERAL AND VERIFIED TRANSLATION OF PCT INTERNATIONAL APPLICATION  
PCT/EP00/01770 FILED ON March 1, 2000

METHOD FOR PRODUCING CIRCUIT ARRANGEMENTS

In many use applications in electronics, circuit arrangements are used with circuit components which, in operation, generate a high dissipation loss, particularly in circuit arrangements with power components such as power modules for controlling of subassemblies. The structural components of the circuit arrangement are secured on a suitable carrier body. For example, in automotive electronics frequently surface mountable power components are used which rest with their back connector surfaces on a printed circuit board forming the carrier body. In order to assure a sufficient heat removal of the dissipation loss of the structural components, particularly the dissipation loss of structural power components, it is possible on the one hand to facilitate the vertical heat transport in the carrier body by thermal through contacts or so-called thermal vias introduced into the carrier body, i.e. lead-through contacts passing from the front side to the back side of the carrier body. As a rule, for this purpose lead-throughs are formed in the carrier body directly under the back side connector surface or support surface of the structural components, particularly the power components. These lead-throughs are metallized on their entire surface and throughout, for example by means of a copper coating. On the other hand, to achieve an external heat removal the carrier body can be secured on a metallic cooling body, for example an aluminum plate, whereby the cooling body can conduct the dissipation loss to a cooling system and the cooling body is

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separated from the carrier body by an electrically insulating layer, for example an insulation film.

After the securing of the structural components on the top surface of the carrier plate, namely the attachment surface, the components are contacted with connector pads and/or with conductors of a printed circuit structure by a soldering process, whereby soldering paste is printed onto the connector pads and onto the surface of the thermal "vias". Then the soldering paste is melted in a reflow soldering process. Thereby solder or solder spatter or also melted portions of the printed circuit structure can be pulled by capillary effects through the thermal vias to the underside of the carrier body, whereby the electrical isolation layer can be damaged. For example, an insulation film secured to the underside of the carrier body may be pierced whereby electrical short-circuits may be caused to the metallic cooling body or to a housing enclosing the carrier body and the circuit arrangement.

German Patent Application DE 198 42 590 which is not a prior publication, describes a method for producing of circuit arrangements in which prior to the soldering process, i.e. prior to the attachment of the structural components to the printed circuit board, all lead-through contacts or thermal vias provided in the carrier body are closed by a screen printing. The screen printing is applied to the backside or underside of the carrier body opposite the upper side or component carrying side of the carrier body. Thereby the diameter of the thermal vias is adapted to the respective, applied screen printing technique. The diameter is so predetermined that a sufficient covering of



the thermal vias within the opening volume is taking place. For example, a certain minimal filling inside the thermal vias may be required. Further, only a small covering of the margin areas bordering on the thermal vias by screen printing material should occur on the underside of the carrier body because a coating of the connector pads provided on the underside of the carrier body with screen printing material would make worse the thermal transition and thus the removal of the dissipation heat, and because for further method steps in the production of the circuit arrangement, a plane surface of the undersigned of the carrier body is desirable. However, the effort and expense for the screen printing process is rather high because narrow tolerances must be maintained for keeping the protrusions of the screen printing material as small as possible.

It is the object of the invention to indicate a simple method for producing circuit arrangements having advantageous characteristics regarding the heat dissipation, the reliability, the costs and the manufacturing process.

This object is achieved according to the invention by the features of the characterizing clause of patent claim 1.

Advantageous embodiments of the invention are defined in the further patent claims.

The screen printing process for the introduction of the screen printing material into the thermal lead-through contacts or thermal vias is performed following the application of a first metallizing layer, preferably copper, forming the base

metallization on the carrier body. Specifically, the screen printing is performed prior to the application of at least one further metallizing layer forming the final metallization, whereby the screen printing material is printed over the openings for the thermal lead-through contacts onto the base metallization without maintaining close tolerances. Following the printing and curing of the screen printing material the remainders of the screen printing material protruding on the underside of the carrier body are removed by at least one mechanical cleaning process, whereby on the one hand a plane and on the other hand a clean (shiny) surface is provided which makes possible a better operation for following method steps, for example for the application of further metallizing layers for the end metallization and during the application of an isolation film applied for improving the heat conduction. Particularly, the mechanical cleaning process is performed as a machine brush grinding because this permits a variable control of the material removal by the parameters of the brush grinding machine which is thus well adaptable to the actual operating conditions. Additionally, further mechanical and/or chemical cleaning processes may be optionally performed. Advantageously, cleaning processes which are usually applied in the production process of the circuit arrangement may be employed. After the removal of the protruding screen printing material, at least one further metallizing layer for the formation of the end metallization is applied to the clean and smooth base metallization. For example, a nickel-gold metallization is chemically deposited on the copper layer of the base metallization. Thereafter, an electrically insulating, thermally conducting film is applied to the plane surface of the backside of the carrier body. This film functions

as an electrical insulation film and as a heat conducting film. The film fully covers the surface area without any air gaps. That as, the film can be applied with a high mounting certainty and is a direct and thermally full cover over the entire surface of the thermal vias.

During the screen printing process a screen printing film is arranged around the thermal vias and the screen printing material is printed into the openings of the thermal vias from the underside of the carrier body in at least a two-stage printing operation in order to achieve a defined filling volume. Highly viscous thixotropic, paste-like materials which are preferably free of solvents, are used for the screen printing, whereby the screen printing material can be selected with due regard to the material of the carrier body, particularly a solid epoxy material free of solvents is used which has a minimal volume reduction or shrinking during curing. The carrier body is dried and the screen printing material is cured following a testing of the closed openings, for example by an optical inspection with a counterlight or by means of an automated vacuum test which determines the extraneous air component for recognizing possibly present holes. Following the cleaning process with the removal of excess screen printing material and following the application of the metallizing layers for forming the finished metallization, the structural components of the circuit arrangement are soldered to the upper surface of the carrier body, for example by means of a reflow soldering process. Since the thermal vias are closed, contaminations of the underside of the carrier body can be prevented, particularly contaminations caused by a flow of solder from the upper side to the lower side or backside of the

carrier body through the thermal vias. The heat transport from the upper side to the underside of the carrier body is not, however, impaired by the screen printing material closing up the thermal vias.

- 5 A volume reduction or shrinking of the screen printing material during curing can be avoided by using a screen printing material that is free of a solvent, particularly a solid epoxy so that no bubbles or cracks can occur in the screen printing material. Such cracks or bubbles would impair the reliability of the closure of the thermal vias.

The printing operation of the screen printing material into the thermal vias is performed as often as necessary, at least however, twice in a row, until the desired thickness of the screen printing material in the thermal vias, meaning a certain filling volume in the thermal vias, has been reached and a complete surface area covering of the openings of the thermal vias on the underside of the carrier body with the screen printing material has been achieved.

- 20 The present method for producing circuit arrangements is safe and simple. It is an advantage that a solder throughflow through the thermal vias provided in the carrier body is prevented with small costs independently of the configuration of the thermal vias, that is independently of the type of lead-through contacting, for example of the screen printing material. This advantage is achieved even for larger diameters of the thermal vias, for example with a diameter in the range of 0.4 mm to 1.0 mm without impairing the thermal conduction through the thermal vias.

Simultaneously the underside of the carrier body is improved for further method steps during the production of the circuit arrangement, in a simple manner without any additional effort and expense, for example for the application of further metallizing layers or of the insulation film.

The present method shall be described in the following text with reference to an example embodiment and with reference to the drawing.

Fig. 1 shows in a sectional view of a portion of a circuit arrangement arranged on a carrier body including a power structural component; and

Fig. 2 shows an enlarged scale illustration of a thermal lead-through contact or thermal vias from the upper side to the underside of the carrier body.

The circuit arrangement on the upper side 12 of a carrier body 5, which for example is constructed as a printed circuit board, comprises in addition to other active and passive structural components also at least one power component 1 having connector contacts 3 which are to be conductively connected with the contact pad 16 which in turn is connected to the printed circuit structure applied on the carrier body or printed circuit board 5, for example in the form of a copper printed circuit structure for example coated by a nickel-gold (AuNi) coating. The lead throughs, for example in the form of bores, are provided in the printed circuit board 5 for the vertical dissipation of heat which is produced during the operation of the circuit

arrangement. The heat to be dissipated is produced particularly by the power components 1. Hence the lead throughs are provided in the area of the power components 1. The walls of the lead-throughs are completely covered over the entire surface area by a metallization layer 6, for example of copper, to form the thermal through contacts or thermal vias 7. After metallization the bores still have a diameter of, for example 0.5 mm. The power components 1 rest with their cooling flag 2 on the openings 15 on the upper side of the carrier body or printed circuit board 5. The openings 15 lead into the thermal vias 7 so that an efficient heat transfer from the upper side 12 of the printed circuit board 5 to the underside 13 of the printed circuit board 5 is made possible. The heat to be dissipated from the underside 13 of the printed circuit board 5 passes by means of cooling ribs 11 to a cooling system. The cooling ribs 11 are made of cooling sheet metal and are part of a metallic cooling body 10. A thermally conducting, electrically insulating film 9, referred to as insulation film or heat conducting film, is arranged between the underside 13 of the printed circuit board 5 and the cooling sheet metal 10 for electrically insulating.

The circuit components of the circuit arrangement are, for example, to be soldered to the top surface 12 of the printed circuit board or carrier body 5 by means of a reflow soldering process. In order to prevent a throughflow of the solder 4 from the upper side 12, of the printed circuit board 5 to the underside 13 of the board 5 during the soldering of the components on the upper side 12, which is the reflow side or attachment side of the board 5, the thermal vias 7 are closed

from the underside 13 of the board 5 prior to the soldering operation by means of a screen printing process.

After the application of the base metallizing 6, for example of copper having a coating thickness of 70  $\mu\text{m}$  on the surface of the board 5 and in the thermal vias 7 and the structuring thereof, the thermal vias 7 are closed by means of screen printing. For this purpose a screen printing film having a diameter of, for example 0.7 mm, is applied around the openings 14 of the thermal vias 7 on the underside 13 of the board 5. For example, the openings 14 have a diameter of 0.5 mm. For this purpose the diameter of the screen printing film does not need to be particularly precisely determined, i.e. the film may have wide tolerances. The screen printing material 8, for example a solid epoxy material, is printed into the openings 14 of the thermal vias 7 on the underside 13 of the printed circuit board 5. A two-step printing operation is employed, also referred to as double-printing or twice wet-on-wet printing. The printing is performed in such a way that a certain filling volume is achieved in the thermal vias 7, that is, a minimal filling level of the screen printing material in the thermal vias 7 at the narrowest point thereof is achieved. For example, the filling level should be at least 15% of the thickness of the printed circuit board or carrier body 5. Further, the printing is performed so that the cured screen printing material 8 does not have any defects, for example, inclusions, air bubbles, pores, etc. The printing is performed so that no screen printing material flows through the lead throughs or bores to avoid contaminating the top side 12 or component side of the printed circuit board 5. A certain layer coating of the screen printing material 8 results on the surface

of the underside 13 of the printed circuit board 5. For example, the layer thickness of the screen printing material 8 is within the range of 30 to 40  $\mu\text{m}$ .

Following the curing of the screen printing material 8 the screen printing material 8 is removed from the surface of the underside 13 of the printed circuit board 5. Particularly, the screen printing material 8 in the area of the openings 14 and around these openings on the underside 13 of the printed circuit board 5 is removed by a chemical and mechanical cleaning process, whereby for example a mechanical brush grinding is used. Such brush grinding is applied during the production of printed circuit boards. This cleaning process is performed, for example for 30 seconds so that the screen printing material 8 is completely removed, except for example for a maximal protrusion of 100  $\mu\text{m}$  of the screen printing material 8 on the surface of the underside 13 of the printed circuit board 5. Thus, the base metallization 6 is prepared for the further method steps without impairing the screen printing material 8 present in the thermal vias 7. Then, the final metallization is applied to the clean base metallization 6 by applying further metallization layers 17 by deposition, for example all accessible areas having a clean base metallization 6 of copper are chemically nickel plated and gold plated. This further metallization layer 17 of chemically deposited nickel-gold has, for example a layer thickness of 3 to 8  $\mu\text{m}$ . Now on the underside of the printed circuit board 5 the electrically insulating and thermally conducting film 9 is applied over the entire surface and flush therewith, for example in the form of a heat conducting film having a thickness of 150  $\mu\text{m}$ .



Latent Claims

- 1     **1.**   Method for producing of circuit arrangements, the  
2           components of which are attached to the top surface (12) of  
3           a carrier body (5) having thermal through contacts (7),  
4           wherein the thermal through contacts (7) are closed from  
5           the underside (13) of the carrier body (5) with screen  
6           printing material (8) by a screen printing process prior to  
7           the soldering operation,  
8           characterized in that  
9           the screen printing process is performed following the  
10          application of a first metallizing layer (6) to the carrier  
11          body (5), said metallizing layer forming a first base  
12          metallization,  
13          and that, following the curing of the screen printing  
14          material (8), remainders of the screen printing material  
15          (8) protruding from the underside of the carrier body (5)  
16          are removed by at least one mechanical cleaning process  
17          and/or by a chemical cleaning process.
- 1     **2.**   Method of claim 1, characterized in that mechanical brush  
2           grinding is used as said mechanical cleaning operation.
- 1     **3.**   Method of claim 1 or 2, characterized in that, following at  
2           least one cleaning process, a metallizing layer (17)  
3           forming the final metallization is applied to the base  
4           metallization (6).
- 1     **4.**   Method of one of the claims 1 to 3, characterized in that  
2           following the application of the metallization layer (17)

forming the final metallization, the components of the circuit arrangement are attached to the top surface (12) of the carrier body (5) by a reflow soldering process.

5. Method of one of the claims 1 to 4, characterized in that a thermally conducting, electrically insulating film (9) is applied to the underside (13) of the carrier body (5).

6. Method of one of claims 1 to 5, characterized in that the thermally conducting, electrically insulating film (9) is connected to a cooling body (10).



Docket #4231  
 USSN: 09/914,932  
 Filed: September 4, 2001

Please type a plus sign (+) inside this box → ☐

PTO/SB/01 (10-00)  
 Approved for use through 10/31/2002 OMB 0651-0032  
 U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE  
 Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number

**DECLARATION FOR UTILITY OR  
 DESIGN  
 PATENT APPLICATION  
 (37 CFR 1.63)**

**WITH POWER OF ATTORNEY**

- ☐ Declaration Submitted with Initial Filing OR ☐ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number 4231  
 First Named Inventor Helmut HEINZ

**COMPLETE IF KNOWN**

Application Number /  
 Filing Date  
 Group Art Unit  
 Examiner Name

As a below named inventor, I hereby declare that:

My residence, mailing address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

METHOD FOR PRODUCING CIRCUIT ARRANGEMENTS

(Title of the Invention)

the specification of which

- ☐ is attached hereto  
 OR

☒ was filed on (MM/DD/YYYY) 03/01/2000 as United States Application Number or PCT International

Application Number PCT/EP00/01770 and was amended on (MM/DD/YYYY) (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached?	
				YES	NO
199 09 505.1	Fed. Rep. of Germany	03/04/1999	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)	<input type="checkbox"/> Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto

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**DECLARATION — Utility or Design Patent Application**

hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: ☒ Customer Number **021553**

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PATENT AND TRADEMARK OFFICE

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

**NAME OF SOLE OR FIRST INVENTOR :**☐ A petition has been filed for this unsigned inventor

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or Surname

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☐ Additional inventors are being named on the \_\_\_\_\_ supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto.